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(54) Method and equipment for accurately positioning items in shafts or piles.

(57) A method of locating an element in a borehole is provided, which method comprises (a) lining at least the upper part of the borehole with a shaft lining tube; (b) placing into the lined borehole a locating frame having at its lower end a pair of adjustable guide frames; (c) adjusting the position of the upper part of the locating frame to define an entry point for the element which is to be located in the borehole; (d) adjusting the pair of adjustable guide frames at the lower end of the locating frame to define a locus for receiving said element; and (e) locating said element between said entry point and said locus. In a variant (suitable for some ground conditions) the shaft lining tube is omitted.

There is also provided a locating frame (6) for use in locating an element (19) in a borehole (2), which frame comprises (i) a space frame (6) of rectangular cross-section substantially free throughout its interior (axial) space; and (ii) at one end of said space frame, a pair of adjustable guide frames (9, 10) spaced apart axially from one another and each comprising a movable bar (15) parallel to one side (10) of the space frame (6) and in a radial plane, and drive means (12, 13, 14) for moving said movable bar (15) across the interior of the space frame, the respective movable bars (15) of the two adjustable guide frames (9, 10) being oriented mutually orthogonally.

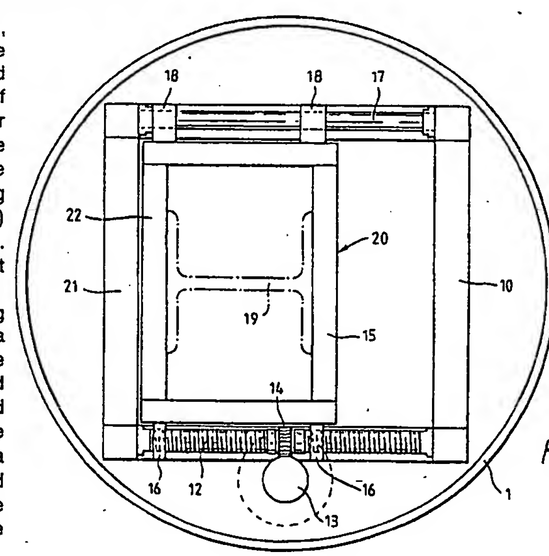

Fig.7.

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Description

METHOD AND EQUIPMENT FOR ACCURATELY POSITIONING ITEMS IN SHAPES OR PILES

On certain types of constructions there is a requirement for an item such as a uniform straight column to be located within a shaft, pile or caisson. Generally the requirement is for the item to be positioned vertically, although other specific orientations may be required from time to time. The item is often a steel section or stanchion and can, for example, be a universal column. It can be of any cross-section. It can be made of steel, as mentioned above but can also be of reinforced concrete or plastic, or a combination of one or more of these. As an example, where cast in place piles are constructed there is sometimes a requirement to position a steel column within or extending into a pile before the concrete sets. Subsequently the steel column may be used to support loads from a structure to be built above the pile. The steel column may also be used to support horizontal beams and/or concrete slabs which may be constructed to prop the walls of a basement construction. This type of construction is known as 'top-down' construction and has time saving advantages to building contractors.

Several methods have been used in the past for positioning vertical items such as the columns mentioned above. For example, during the construction of a cast in place pile a shaft lining tube, usually either of steel or reinforced concrete, is installed. The bore is then partly filled with concrete. Subsequently when concrete has set a man is lowered down the hole to clean the concrete surface and to fix a base plate or similar device to the head of the concrete. The column is then lowered into position and fixed at the lower level to the base plate using surveying techniques to adjust the column as close as possible to a truly vertical position. The upper section of the column is positioned at or near to ground level. The empty bore is often filled with sand or gravel, although this is not always essential. Frequently the dimensions of the bore make it very difficult to work within the available confines.

In an alternative method, the steel column is supported at or near ground level on a knife-edge arrangement, and the lower end is embedded in the concrete. Still another method is to survey the (generally temporary) casing or shaft bore and to then fix distance pieces to the column such that these distance pieces account for the inaccuracies in positioning the casing or shaft bore, and thereafter to insert the steel column.

The above methods suffer from one or more of the following drawbacks: excessive time required to install the column; uncertainty of its initial positioning; uncertainty of maintaining the column in position while the concrete sets; the requirement generally for long casings (steel or concrete) which often are difficult or impossible to recover; and additional difficulties if the bore is flooded with water or bentonite suspension.

In order to ameliorate the problems inherent in prior techniques, we have devised a method which enables accurate positioning of items such as columns and stanchions to be achieved. More particularly, in one aspect the present invention provides a method of locating an element in a borehole, which comprises (a) lining at least the upper part of the borehole with a shaft lining tube; (b) placing into the lined borehole a locating frame having at its lower end a pair of adjustable guide frames; (c) adjusting the position of the upper part of the locating frame to define an entry point for the element which is to be located in the borehole; (d) adjusting the pair of adjustable guide frames at the lower end of the locating frame to define a locus for receiving said element; and (e) locating said element between said entry point and said locus. In a variant (suitable for some ground conditions) the shaft lining tube is omitted.

According to another aspect of the present invention there is provided a locating frame for use in locating an element in a borehole, which frame comprises (i) a space frame of rectangular cross-section substantially free throughout its interior (axial) space; and (ii) at one end of said space frame, a pair of adjustable guide frames spaced apart axially from one another and each comprising a movable bar parallel to one side of the space frame and in a radial plane, and drive means for moving said movable bar across the interior of the space frame, the respective movable bars of the two adjustable guide frames being oriented mutually orthogonally. Preferably the movable bar of each adjustable guide frame is part of a movable, planar rectangular unit which can be moved by the drive means from a first position adjacent to one side of the space frame to a second position adjacent the opposite side of the space frame. A modification can also be envisaged in which there is just a single guide frame unit carrying orthogonally oriented adjustment bars with their respective drive means.

A locating frame in accordance with this invention may have a further adjustable guide frame or pair of such guide frames at the opposite end (top end) of the frame; this is not essential, however, since a separate but analogously functioning unit can be fitted over the top of the locating frame to define an entry point for the element which is to be located within the borehole.

Conventional surveying techniques may be used to ensure alignment of the entry point and lower end locus in practising this invention.

One preferred technique in accordance with the invention will now be described with reference to the accompanying drawings, in which:

FIGURE 1 shows a vertical section through a borehole;

FIGURES 2a-2c illustrate (not to scale) part of a temporary lining tube;

FIGURE 3 illustrates a locating orientation board for use together with the arrangement of Figures 2a-2c;

FIGURE 4 shows the borehole of Figure 1

containing apparatus in accordance with this invention;

FIGURES 5a-5c illustrate sectional views of part of the apparatus shown in Figure 4;

FIGURE 6 illustrates the mode of operation of part of the apparatus shown in Figure 4;

FIGURE 7 illustrates a sectional view through an adjustable guide frame forming part of the apparatus of Figure 4; and

FIGURE 8 illustrates a typical construction project in which the present invention finds application.

A presently preferred embodiment of the method of this invention, as applied to the type of pile construction outlined above, will now be described with reference to the drawings.

(1) As shown in Fig. 1, a temporary casing or shaft lining tube 1 is installed in the normal manner in a borehole 2. As shown in Fig. 2a, the tube 1 has at its upper end a pair of radially opposed locating shoes 4 the construction of which is as shown in Figures 2b (a sectional view along lines A-A of Fig. 2a) and 2c (a sectional view along lines B-B of Fig. 2a). Arranged orthogonally with respect to locating shoes 4 is a pair of support shoes 5. The casing is generally of tubular steel often 3 - 7 metres long, but which may exceptionally be 20 metres or more in length.

(2) The pile is bored conventionally, either dry or under water or bentonite.

(3) Concrete is placed either at this point in time or later, generally up to a position several metres below the top of the temporary casing 1 but above the intended column base level.

(4) A locating device 3 (see Fig 3) is accurately placed on the top of the casing 1. This device 3 comprises a rectangular frame containing a plurality of parallel sight lines 30, typically spaced apart by 25mm, by means of which the orientation of locating shoes 4 may be adjusted.

(5) A locating frame 6 is lowered into the casing 1 and accurately orientated by means of the device 3 (see Figs. 4 and 5). The frame has a top support unit 6a which overlaps the uppermost section of lining tube 1 as shown in Figure 5a. The method of locating the upper end of frame 6 is illustrated in Figure 5b, which is a section along the lines C-C of Fig. 5a. Locating shoe 4 comprises a peg-like portion 40 which sits on top of the lining tube 1, and which has a dowel 41 arranged to cooperate with a bracket 42 through locating slot 43. Frame 6 is generally 3 - 7 metres long, although greater lengths can be used to obtain even greater accuracies of location if desired. The frame 6 may project above the casing 1 into which it is lowered, but it is often substantially or completely located within the casing. Top section 6a (see Figures 4 and 5a) serves to retain the frame 6 in relation to tube 1. Frame 6 is a rectangular space frame the interior space (along and about the longitudinal axis) of which is open. Within the frame 6 there are four adjustable guide frames arranged in two adjacent pairs, those close to the top of frame 6 being identified in Figure 4 as 7 and 8, while those close to the bottom of the frame 6 being identified as 9 and 10.

(6) The frame 6 is then firmly located in position by means of expanding shoes 11 which thrust on to the casing wall 1 or the unlined bore 2 (Fig. 5c). These shoes are located at two or more levels, and may be actuated mechanically, electrically, pneumatically, hydraulically, or by a combination of one or more of these methods.

(7) The frame 6 contains two or more pairs of adjustable guide frames (see Figs. 4 and 7). One pair 7 and 8 is located near the upper end of the frame 6, and another pair 9 and 10 near the base of the frame. The guide frames are generally rectangular and are positioned such that the plane of the guide is normal to the axis of frame 6. For each pair of guides, one is located slightly above the other (Figs. 4 and 7); again, for each pair, one includes a movable bar 15 which can be moved in a predetermined direction, say a north-south direction, whereas the other includes a movable bar which can moved in a direction orthogonal to that of the first bar, e.g. in an east-west direction (see Fig. 6). Each individual guide frame can be remotely operated, either mechanically, electrically, pneumatically or hydraulically, or by a combination of one or more of these methods. Once the bars 15 of the adjustable guide frames have been adjusted they cannot be displaced by means of an external force. As illustrated in Fig. 7, each of the adjustable guide frames includes a worm drive 12 driven by a hydraulic motor 13 through a drive gear 14. The movable bar 15 is, in this embodiment, in the form of a rectangular unit 20 carried along the worm drive (12) by shoes 16. That side 22 of unit 20 opposite bar 15 is free to slide along a bar 17 by means of shoes 18. The overall permissible movement of rectangular unit 20 is between the limits set by opposite sides 10 and 21 of the adjustable guide frame.

(8) After the frame 6 has been positioned as described above, the steel column 19 is lowered through the guides 7-10 at the top and bottom of the frame. The position of the steel column at or slightly above the top of the frame is then adjusted by means of the upper guide frames 7 and 8, until the column is in the desired position, this being confirmed for example by means of surveying equipment. The lower guide frames 9 and 10 are then adjusted until the column is at the correct inclination (generally vertical). Confirmation of the inclination may be by means of either surveying techniques or by means of spirit levels.

(9) The steel column 19 is then lowered further into its final position and kept at this level by means of, for example, a crane or a separate clamping arrangement. Concrete may have already been placed (see (3) above) or may be placed after the installation of the frame

6, or even after the final positioning of the steel column 19. The concrete may be placed by means of a chute, a tremmie pipe or it may be pumped down the pile. Generally the concrete level will be below the lower limits of frame 6.

(10) Once the concrete has set the frame 6 is removed. The empty bore nay be filled with a suitable backfill material and the casing 1 withdrawn.

(11) Instead of there being two pairs of adjustable guide frames (i.e. the upper pair 7 and 8, and the lower pair 9 and 10), the system described above may be modified so that there is only one adjustable guide frame at each end of the frame 6. With this modification, each of th'a adjustable guide frames is provided with two bars such as the bar 15 of Fig. 7, the two bars being movable in mutually orthogonal directions to provide the necessary clamping/ support action to hold the steel column 19 in place. It will also be appreciated that the upper adjustable guide frame or frames may be dispensed with, especially where the depth of the borehole 2 is not very great or where the accuracy of location required can be achieved with conventional support means for the upper end of the steel column 19.

The above is an example of the use of this type of frame in a shaft or bore, in which case it would be usual for the frame to be inserted a substantial depth into the shaft/bore. However it is not essential for the frame to be inserted into the shaft/bore. Similarly, whereas it is usual for the steel column to be placed vertically, this system can be used to place the column at any desired inclination. As already mentioned the system can be used to place items such as steel columns and also other items, possibly of different steel sections, but also of concrete (either reinforced or not) or of plastic, or a combination of one or more of these.

This type of frame can also be used to place similar items into other types of pile, for example into piles of the continuous flight auger type. With this technique the frame is generally used above ground, and is accurately located in plan by the use of a heavy base (either of steel or concrete, or a combination) or by means of separate piles (which may be works piles or supernumary piles). The means of obtaining correct orientation is similar to that already described, as is the means of adjusting the frame to obtain the correct plan position and inclination of the steel column or similar.

Preferred embodiments of the present invention may offer one or more of the following advantages:

1. Precise control of the insertion and positioning of a column (or similar) which is to be partly embedded into a cast in place bored pile.

2. The adjustable guide(s) can have controlled clearances within each guide such as to give a predetermined precision of location within a borehole.

3. Robust construction of the device is feasible; this allows insertion of a column without deformation to the device.

4. Precise orientation of the reference frame, and maintenance of the orientation during use, are possible.

5. Accurate positioning both in plan, orientation and indication from ground level or above.

6. Suitability for use in constructing cast in place piles where the bore is flooded (either partially or wholly) with water or bentonite suspension.

7. Suitability for use where a column or the like is to be embedded partly or wholly into a continuous flight auger pile, and sufficient robustness for the location step to to take place above ground.

Claims

1. A method of locating an element in a borehole, which comprises (a) placing into the borehole a locating frame having at its lower end a pair of adjustable guide frames; (b) adjusting the position of the upper part of the locating frame to define an entry point for the element which is to be located in the borehole; (c) adjusting the pair of adjustable guide frames at the lower end of the locating frame to define a locus for receiving said element; and (d) locating said element between said entry point and said locus.

2. A method according to claim 1, wherein at least the upper part of the borehole is lined with a shaft lining tube prior to the locating frame being placed into the lined borehole.

3. A locating frame (6) for use in locating an element (19) in a borehole (2), which frame comprises (i) a space frame (6) of rectangular cross-section substantially free throughout its interior (axial) space; and (ii) at one end of said space frame, a pair of adjustable guide frames (9, 10) spaced apart axially from one another and each comprising a movable bar (15) parallel to one side (10) of the space frame (6) and in a radial plane, and drive means (12, 13, 14) for moving said movable bar (15) across the interior of the space frame, the respective movable bars (15) of the two adjustable guide frames (9, 10) being oriented mutually orthogonally.

4. A locating frame (6) for use in locating an element (19) in a borehole (2), which frame comprises (i) a space frame (6) of rectangular cross-section substantially free throughout its interior (axial) space; and (ii) at one end of said space frame, an adjustable guide frame comprising a pair of movable bars disposed mutually orthogonally in a radial plane and each parallel to one side of the space frame, and drive means for moving said movable bars independently of one another across the interior of the space frame.

5. A locating frane as claimed in claim 3 or 4, characterised in that the movable bar (15) of

each adjustable guide frame is part of a movable, planar rectangular unit (20) which can be moved by the drive means (12, 13, 14) from a first position adjacent to one side (21) of the space frame to a second position adjacent the opposite side (10) of the space frame (6).

6. A locating frame as claimed in claim 3, 4 or 5, wherein the locating frame (6) is provided with a further guide frame or pair of guide frames (7, 8) at the end thereof opposite said one end.

7. A locating frame as claimed in claim 3, 4, 5 or 6, wherein said drive means comprises a hydraulic motor (13), a worm drive (12) and worm gear (14).

8. Apparatus for use in locating a structural element (19) in a borehole (2), which comprises a locating frame (6) as claimed in claim 3, 4, 5, 6 or 7 and a temporary casing or shaft lining tube (1).

9. Apparatus as claimed in claim 8, wherein said shaft lining tube (1) is provided with locating shoes (4) and support shoes (5).

10. Apparatus as claimed in claim 9, wherein said locating shoes comprise a peg-like portion (40) including a dowel (41) which cooperates via a locating slot (43) with a bracket (42).

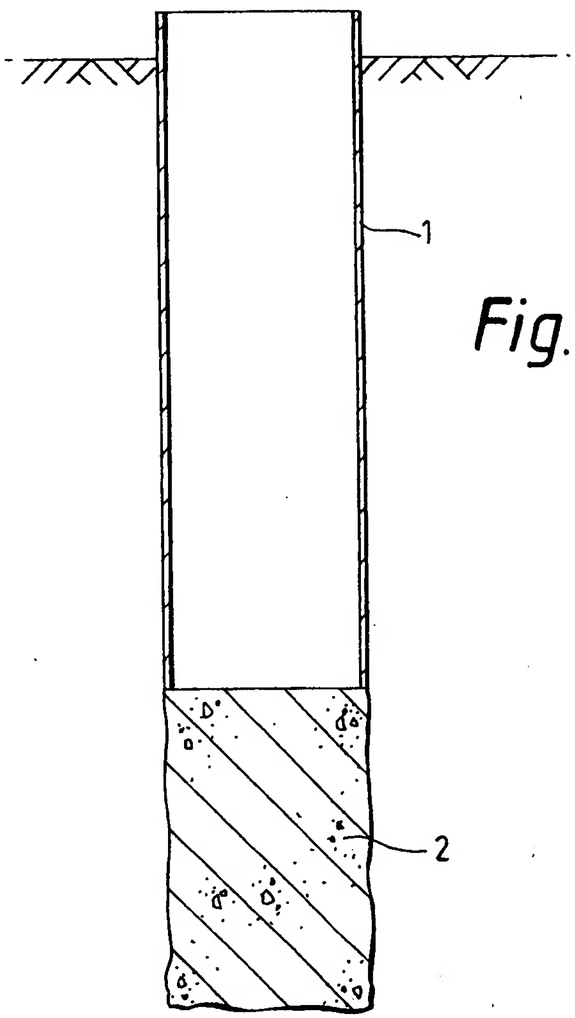

Fig.1.

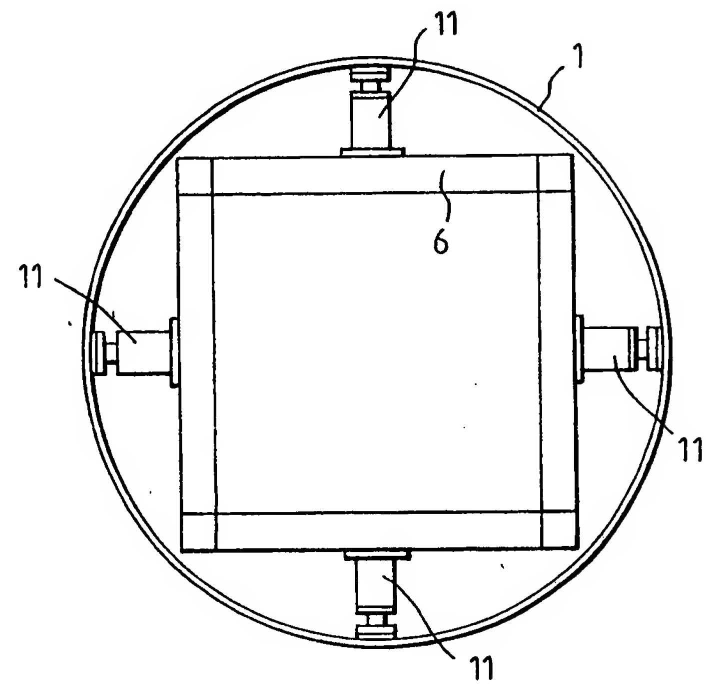

Fig.5c.

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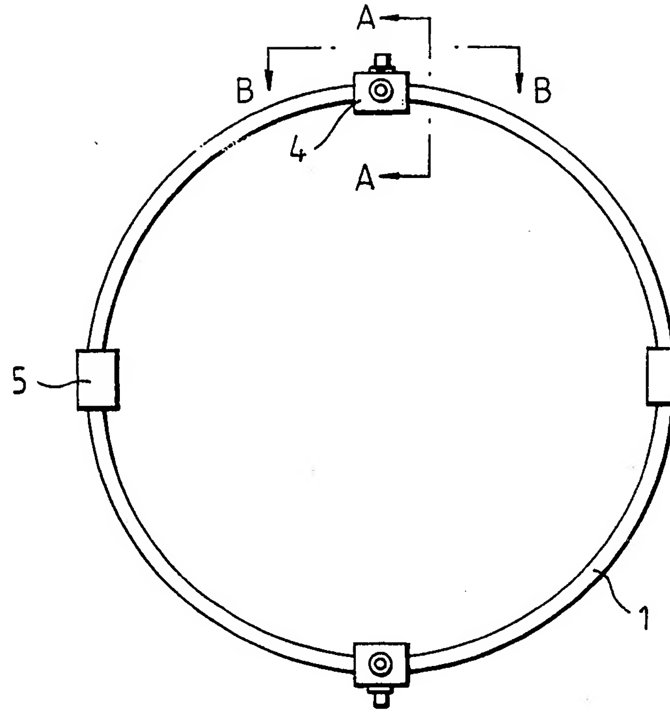

Fig. 2a.

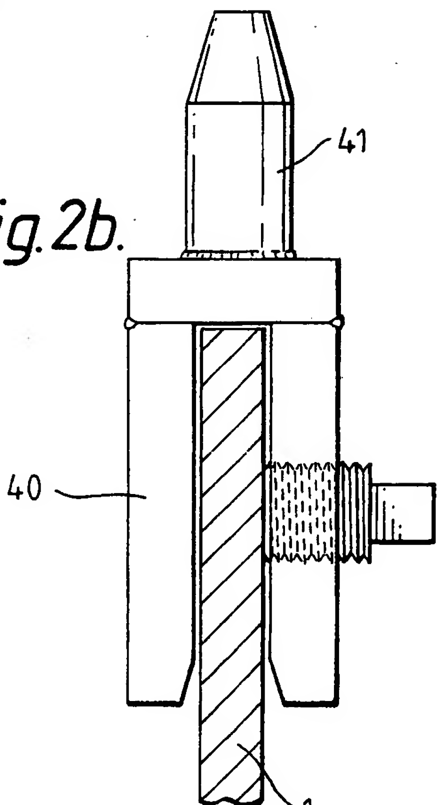

Fig.2b.

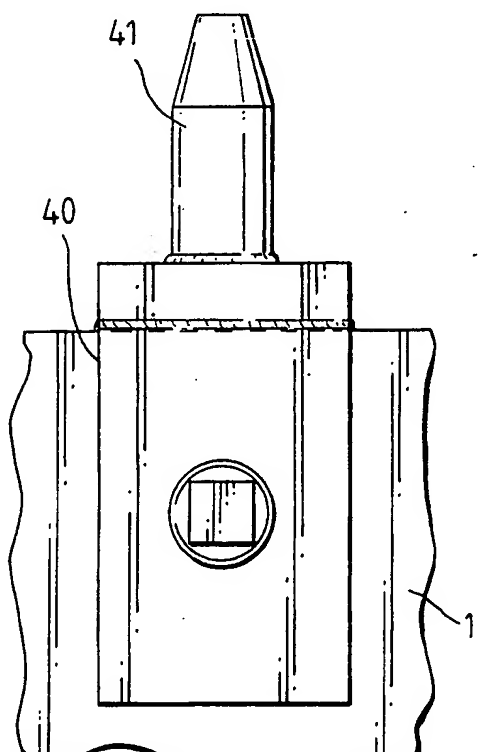

Fig.2c.

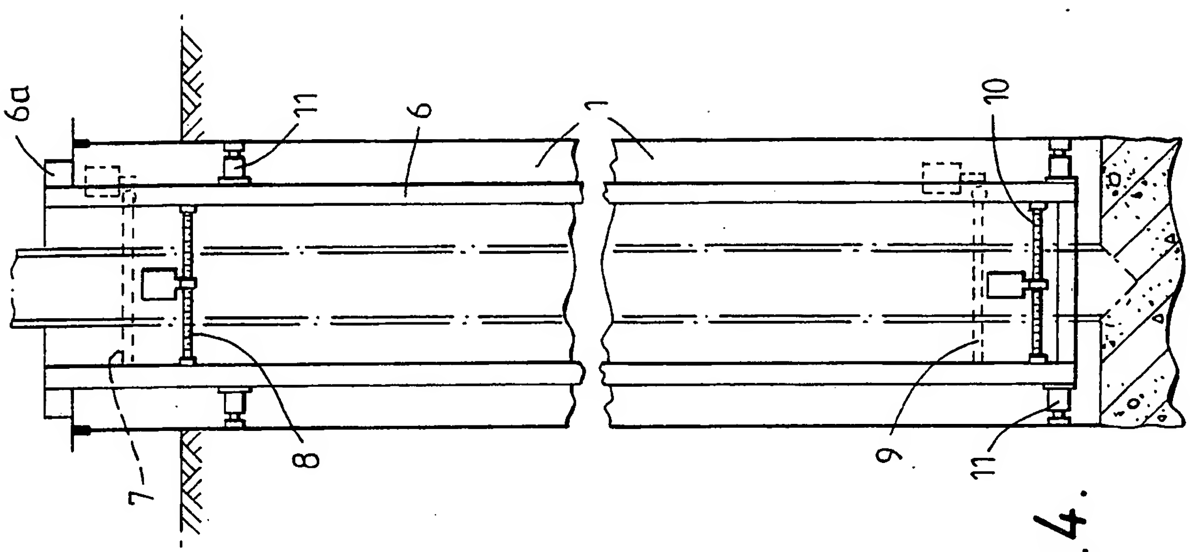

Fig.4.

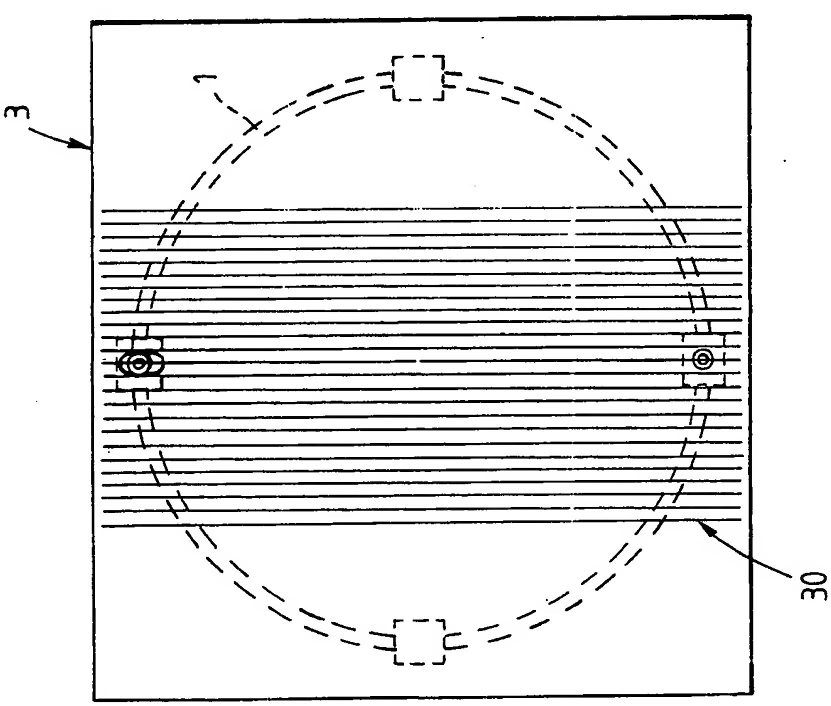

Fig.3.

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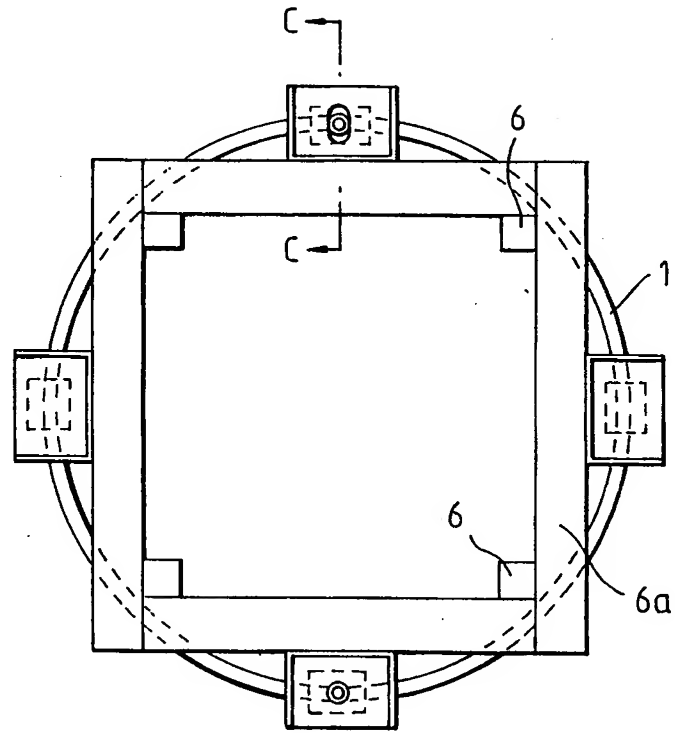


Fig.5a.

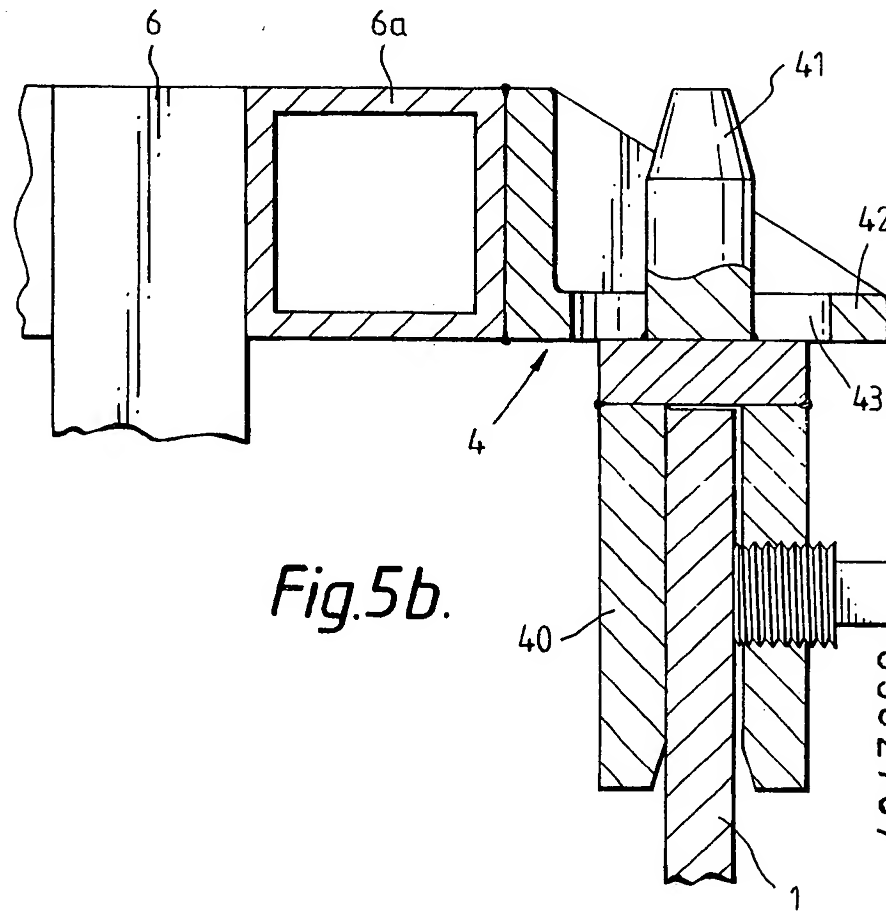


Fig.5b.

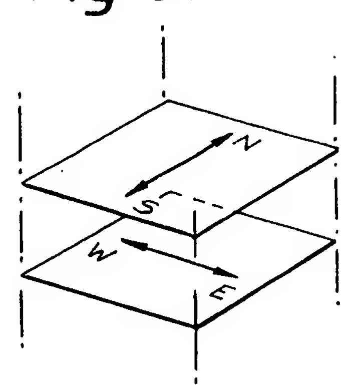


Fig. 6.

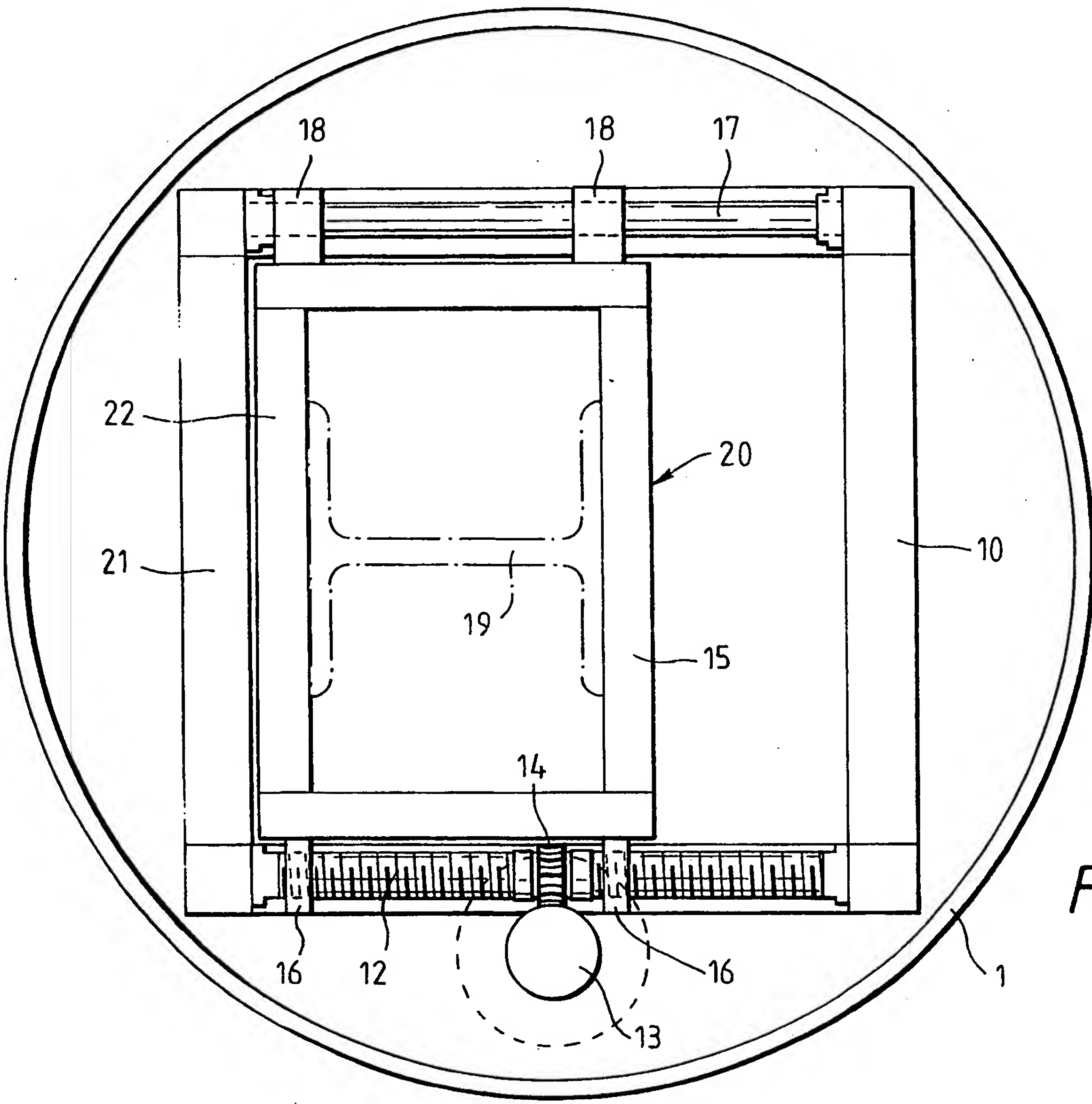
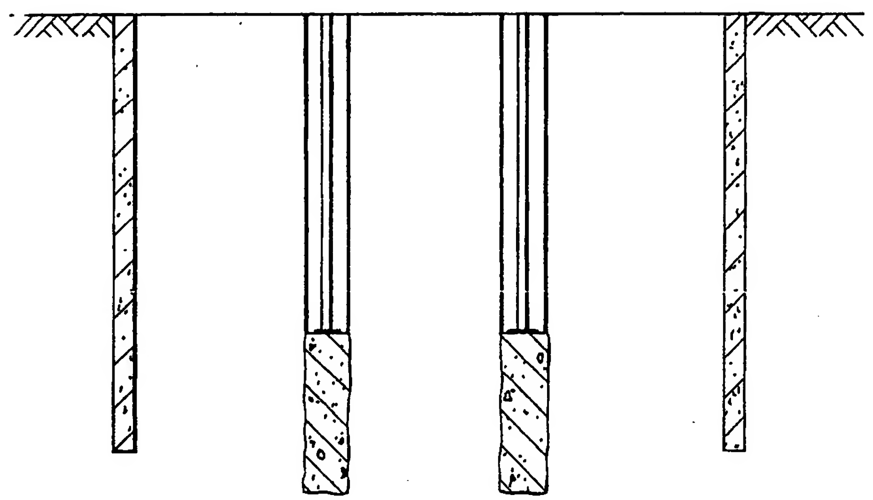


Fig. 7.

Fig. 8a.



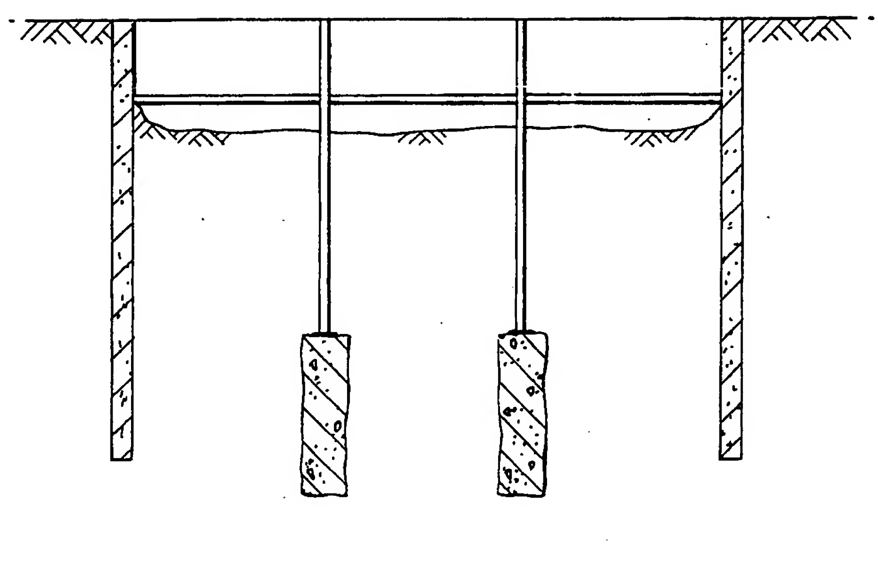


Fig. 8b.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 88 30 7140

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	FR-A-2 481 726 (CENTRE TECHNIQUE INDUSTRIEL DE LA CONSTRUCTION METALLIQUE) * Page 3, line 21 - page 4, line 7; page 4, lines 15-21; figures 1-5 *	4	E 02 D 27/42
Y		1	
A		3	
Y	EP-A-0 126 656 (G. PEREIRA et al.) * Page 3, line 33 - page 4, line 26; figures 1,2 *	1	
A		2,6,8	
A	US-A-3 236 055 (TOKOLA) * Column 3, line 31 - column 4, line 24; figures 8,9 *	3,5,7	
A	US-A-4 484 842 (B. ENGELHAUPT) * Column 2, line 54 - column 4, line 10; figures 1-6 *	3	
A	US-A-4 133 154 (O.J. RUZICKA)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 02 D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21-10-1988	KERGUENO J.P.D.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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